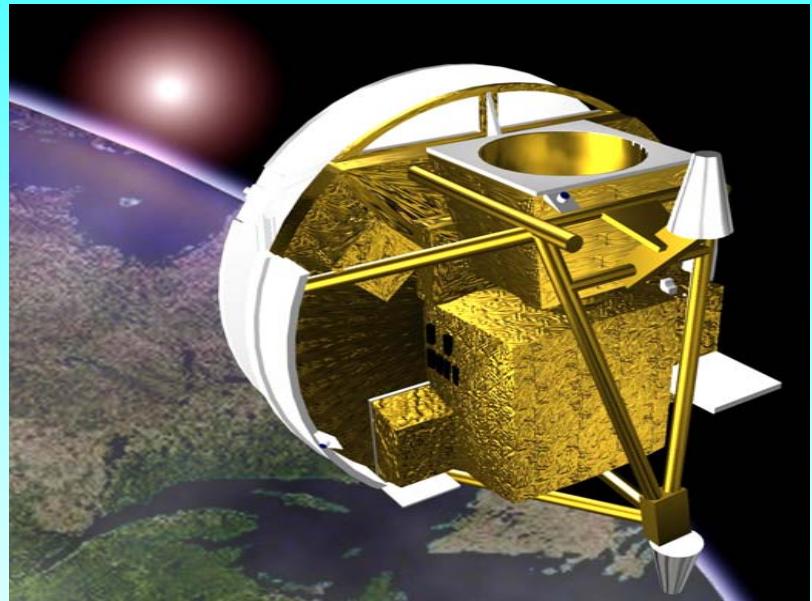


# Carbon monoxide distribution from the ACE-FTS solar occultation measurements

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Chris Boone<sup>3</sup> and Peter Bernath<sup>3</sup>

[ccl@aero.jussieu.fr](mailto:ccl@aero.jussieu.fr)



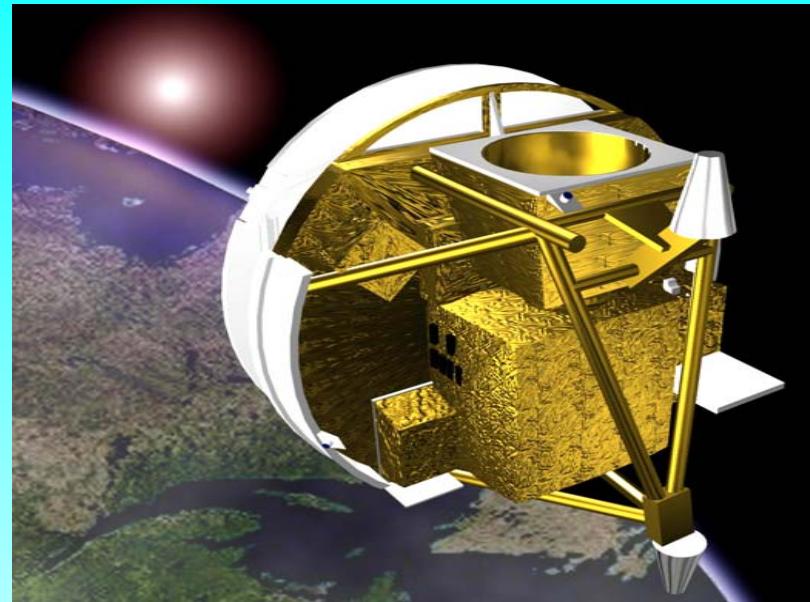
<sup>1</sup> Service d'Aéronomie / CNRS, IPSL, Paris, France

<sup>2</sup> Spectroscopie de l'Atmosphère, Service de Chimie Quantique et Photophysique,  
Université Libre de Bruxelles, Brussels, Belgium

<sup>3</sup> Department of Chemistry, University of Waterloo, Waterloo, ON, Canada

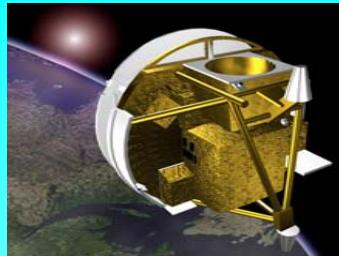
## ACE-FTS

The ACE mission was on 12 August, 2003. The satellite has a 740 inclined circular orbit at an altitude of 650 km and has both global and high latitude coverage.



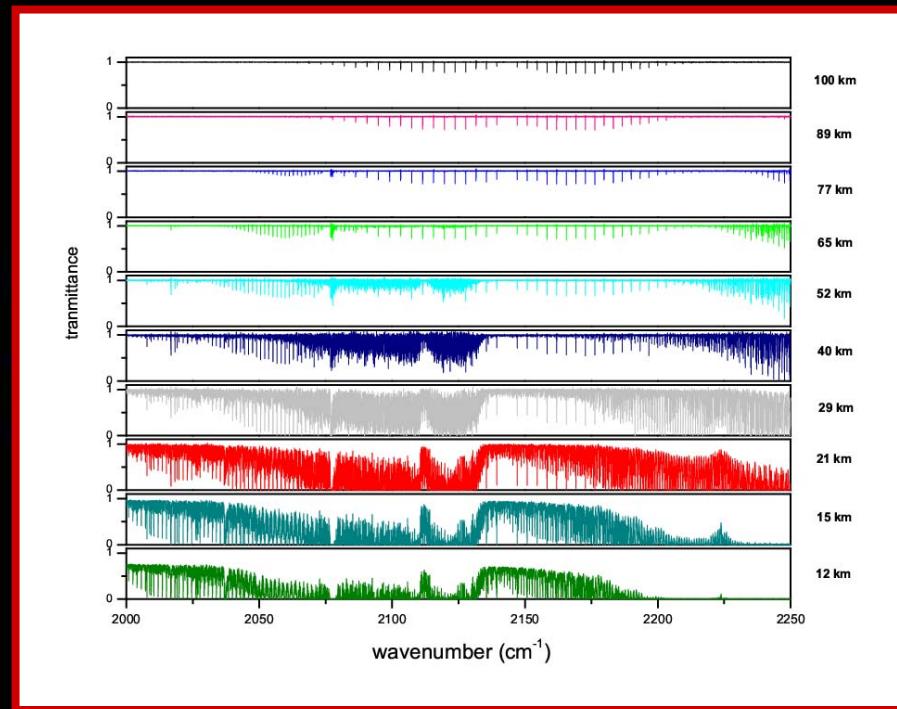
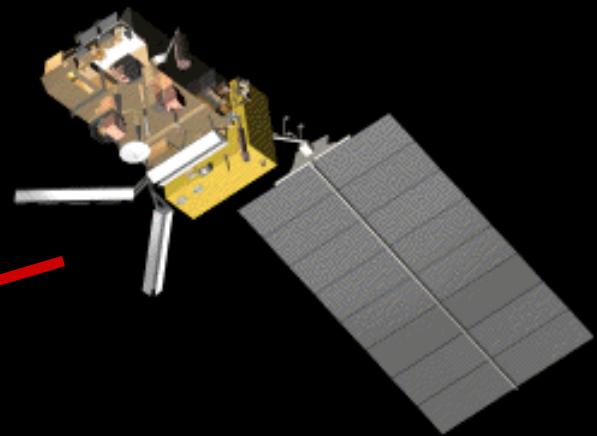
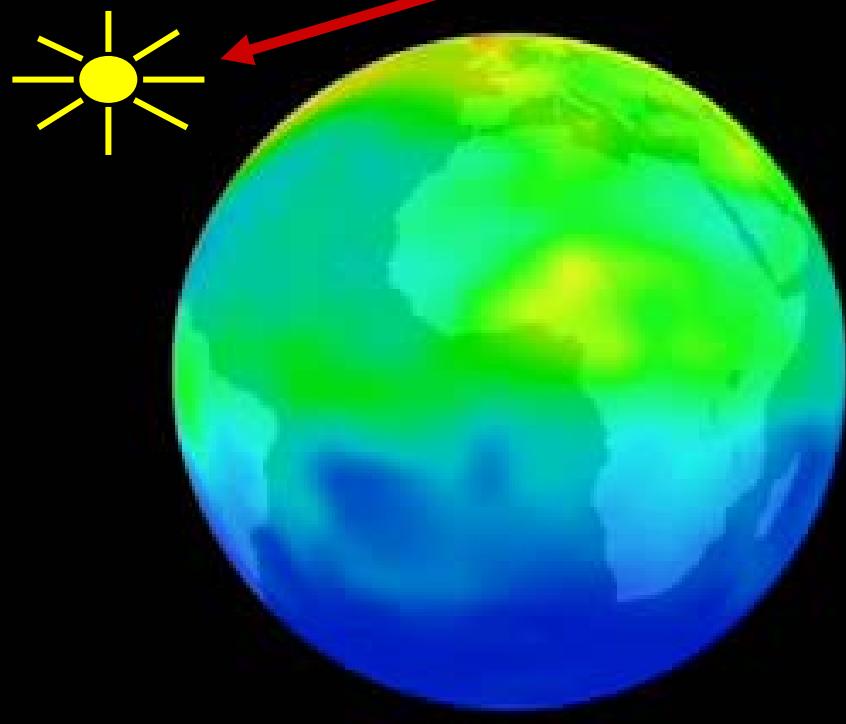
The principal ACE instrument is a high resolution ( $\pm 25$  cm Maximum Optical Path Difference) infrared Fourier transform spectrometer operating from 750 to  $4400\text{ cm}^{-1}$  in solar occultation mode.

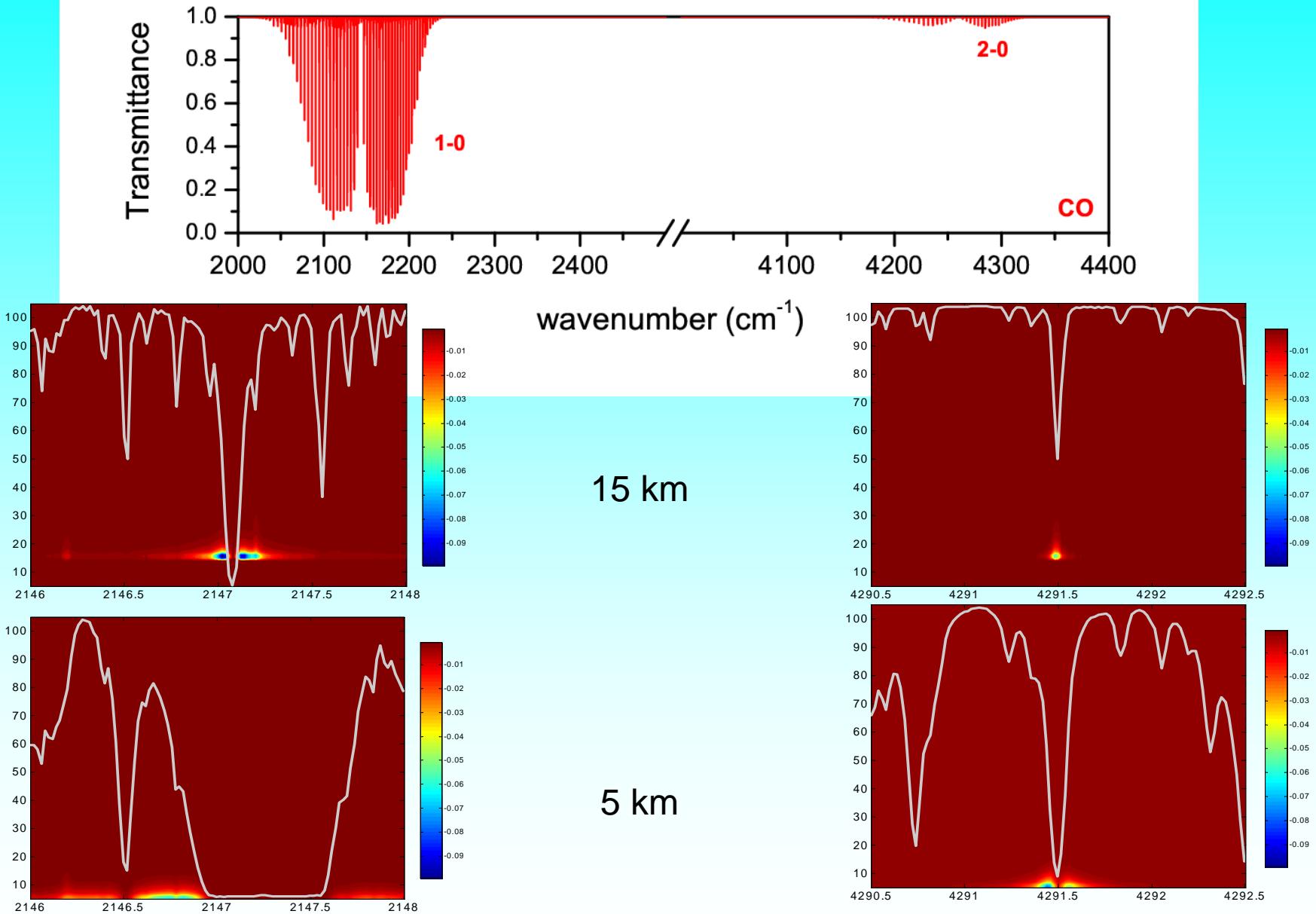
ACE can observe a maximum of 15 sunrises and 15 sunsets per day and measures infrared absorption spectra. These spectra are converted to atmospheric transmittance by division with an exo-atmospheric solar spectrum.

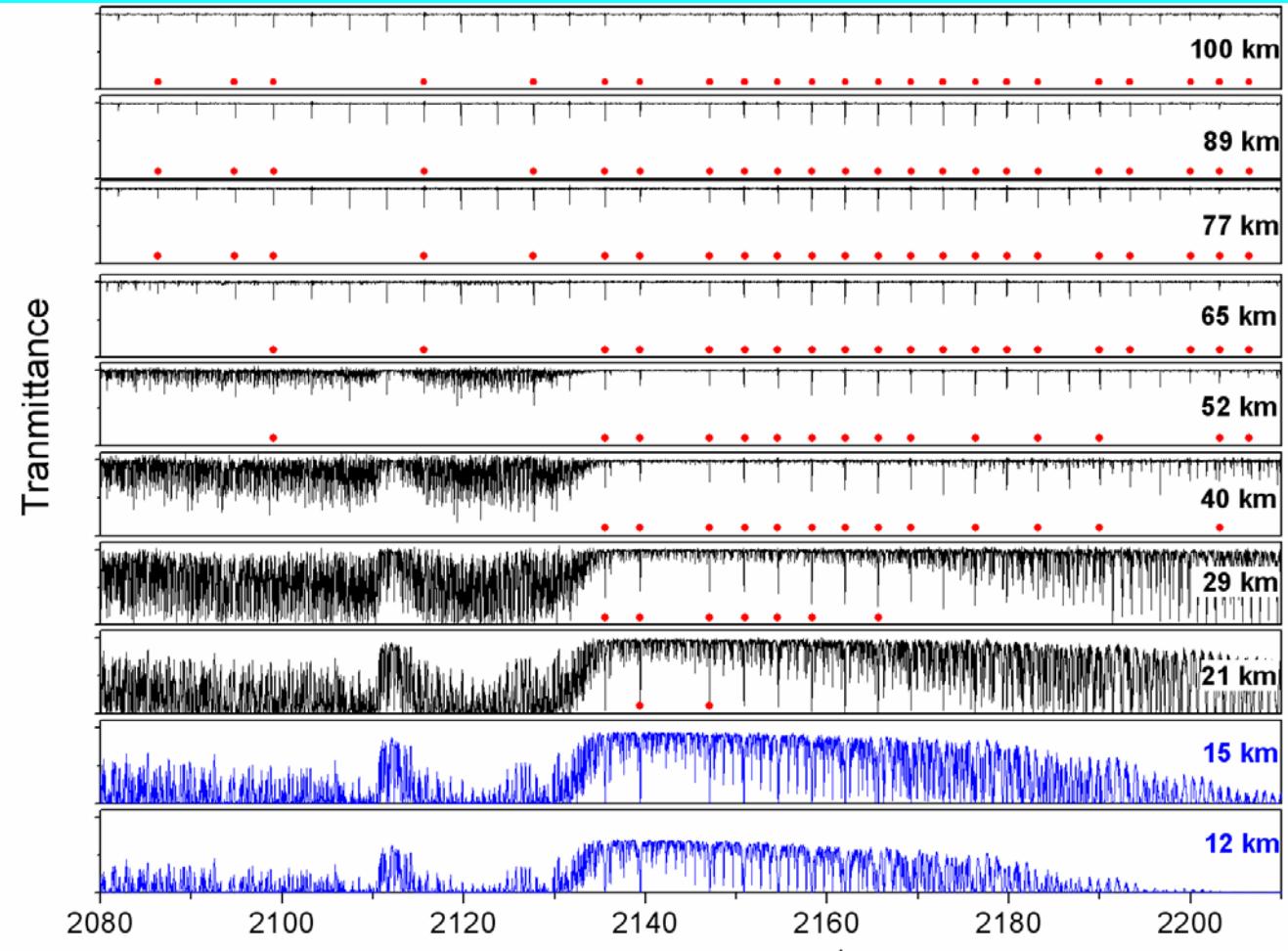
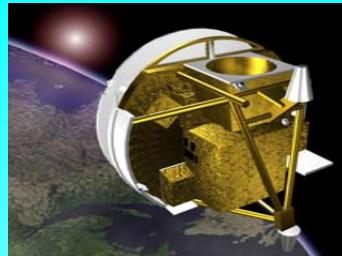


# Outline

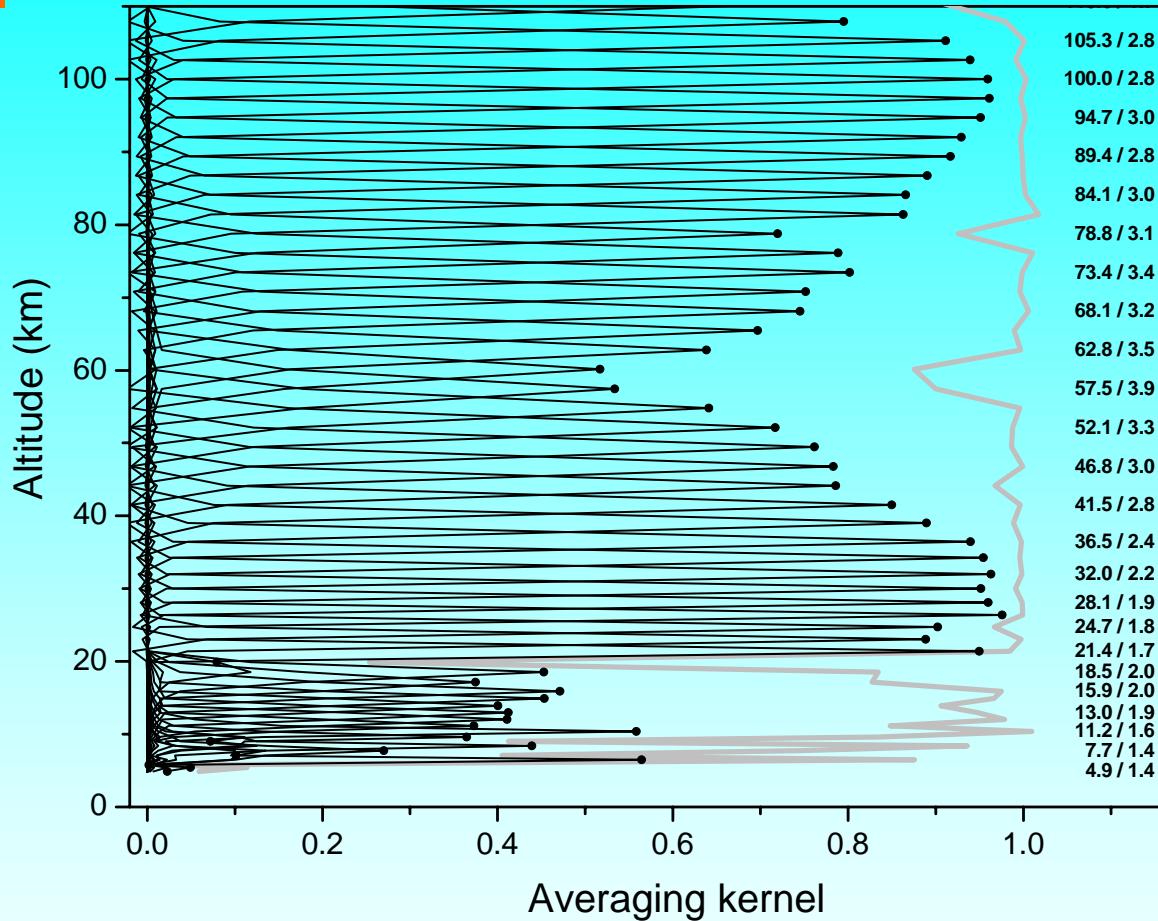
- CO retrieval from the ACE solar occultation spectra
- CO vertical and latitudinal distribution
- CO from biomass burning



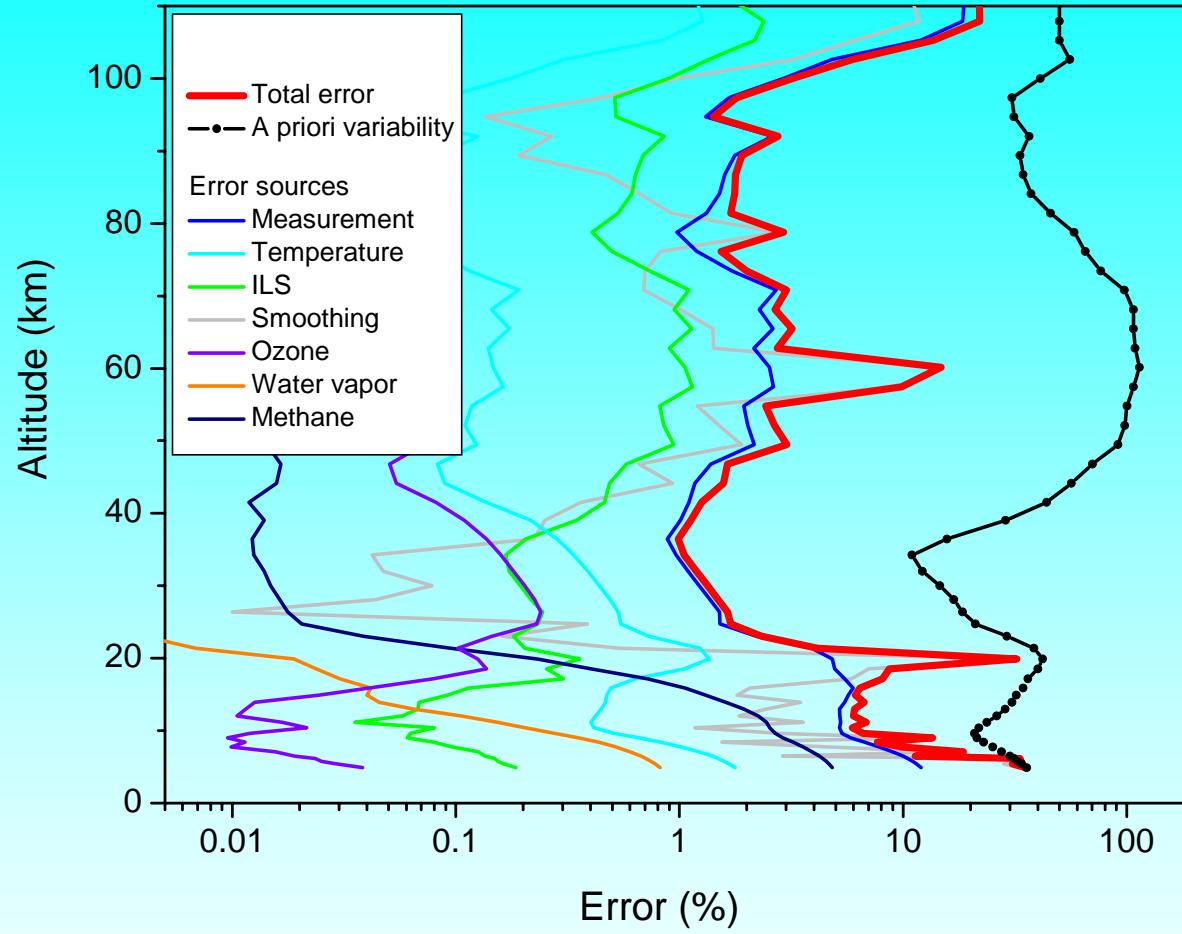




The microwindows used in the operational retrieval, varying with altitude, are identified by red dots. Below 25 km, most of the information is retrieved from the 2-0 overtone band as saturation and interferences due to other trace gases absorption increase when the instrument is sounding deeper in the atmosphere.



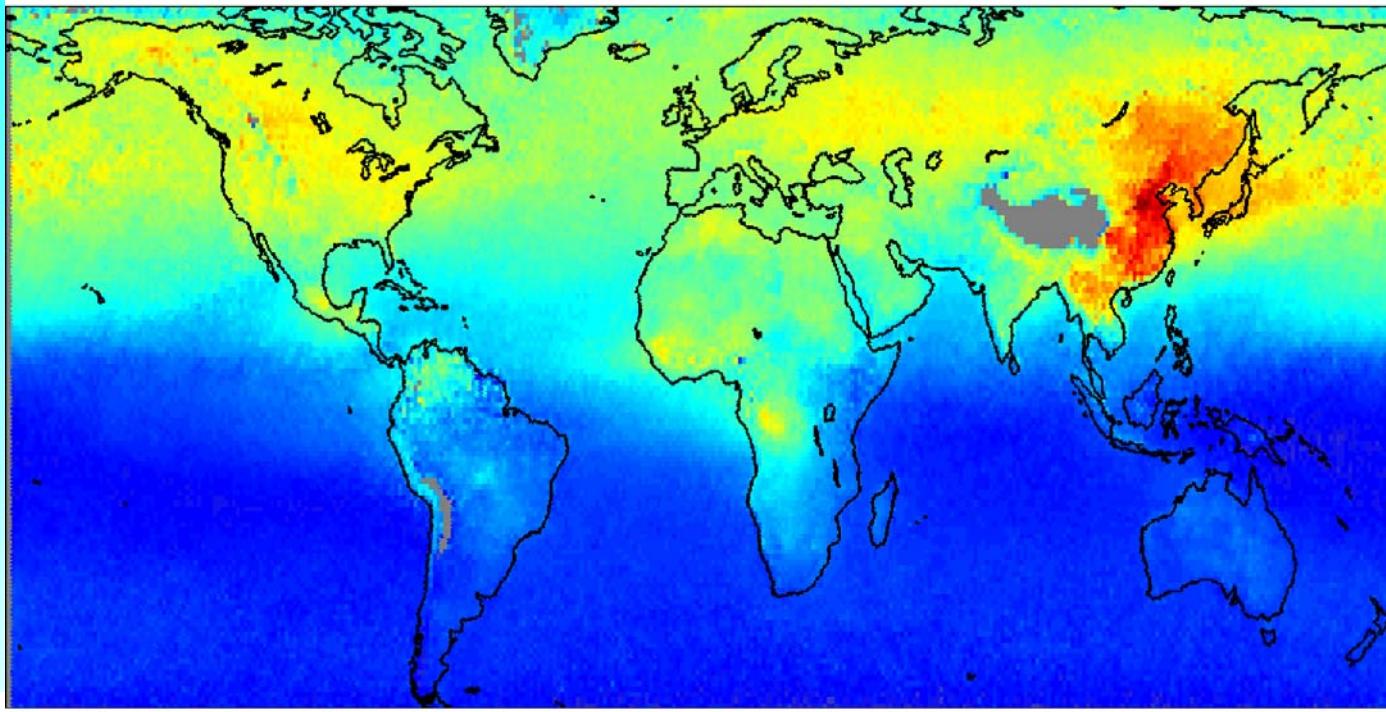
Averaging kernels calculated for an occultation recorded over the Southern Hemisphere tropical region, on August 10, 2004. Plain circles represent the nominal altitude of each kernel and the envelope (grey line) indicates the measurement response.



The total error and the individual contributions due to the measurement noise, to the smoothing and to uncertainties on the temperature, water vapor, methane and ozone vertical profiles, and on the instrumental lineshape, are plotted against the CO variability from model climatologies.

# Troposphere

MOPITT April-May-June

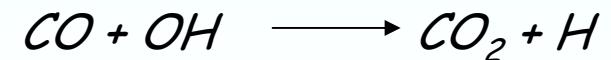


## Sources :

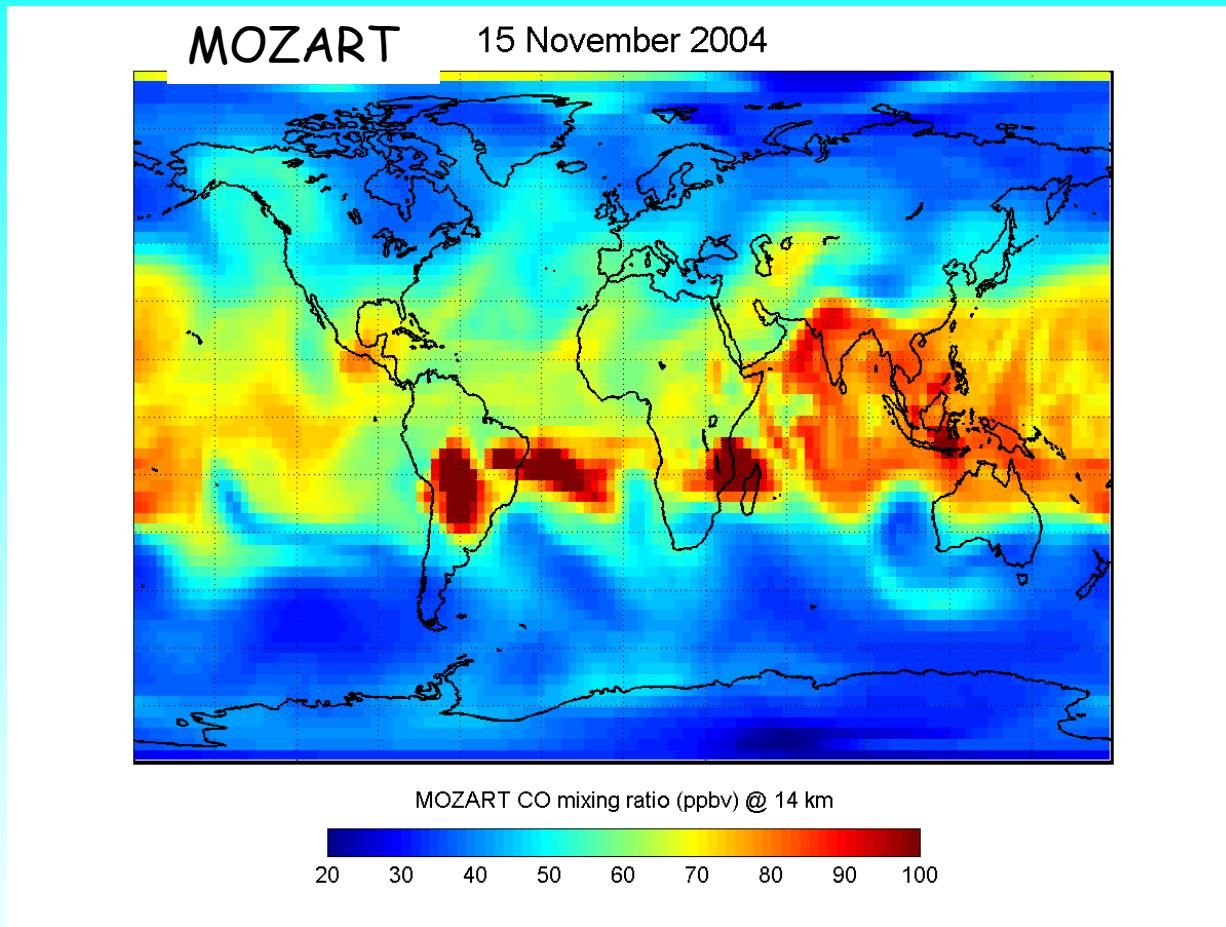
Fuel combustion, vegetation burning

Atmospheric oxydation of  $\text{CH}_4$  (+ hydrocarbons)

## Sink:



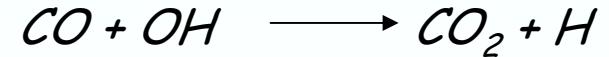
# Upper troposphere/ Lower stratosphere



*Sources :*

Transport (deep convection)

*Sink:*



# Mesosphere/Termosphere

Sources :

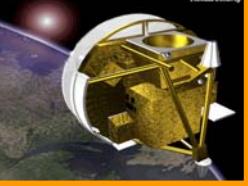


Sink:

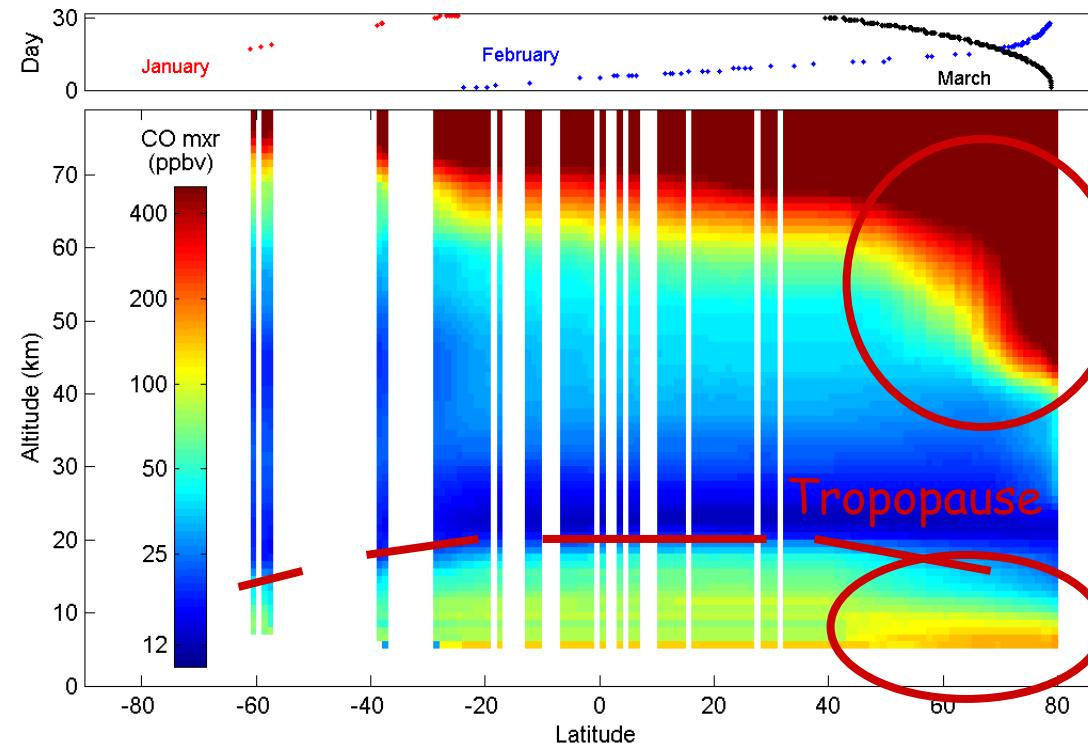


AND:

Competition with **downward transport** (meridional transport from the summer to the winter hemisphere)



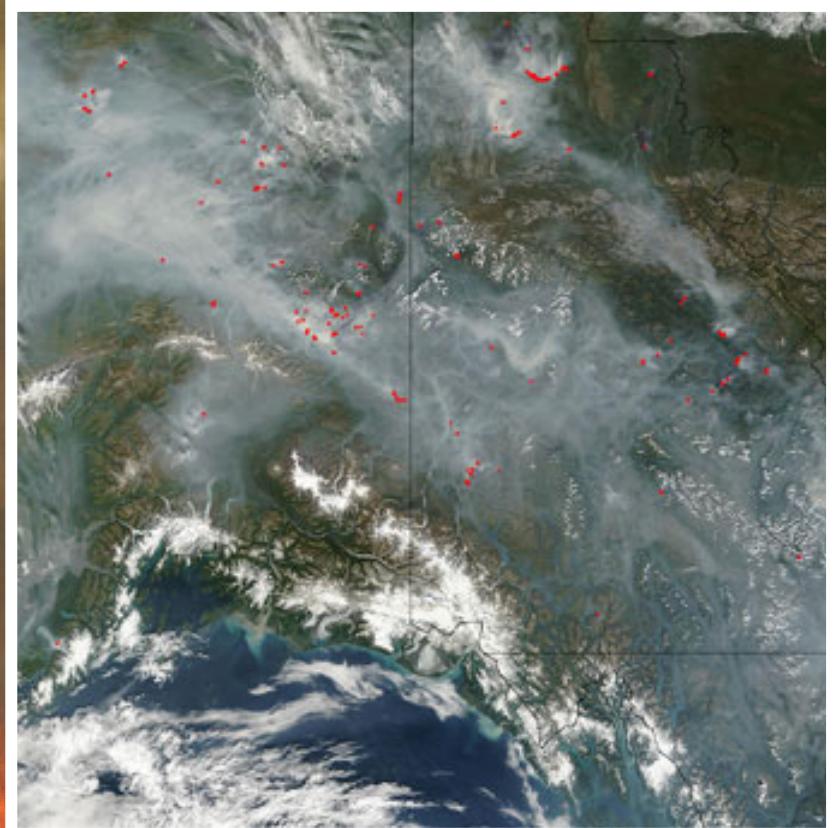
# CO latitudinal variation



Latitudinal averages of CO mixing ratio profiles observed by ACE-FTS for the January to March 2004 period (corresponding to 508 occultations), plotted with a logarithmic colorscale.

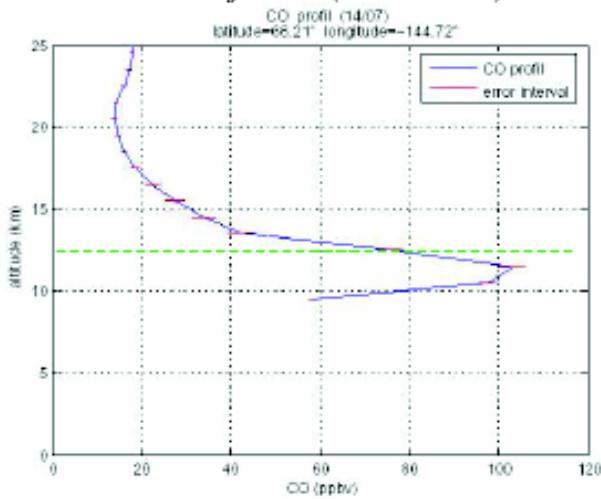
Clerbaux *et al.*, GRL, 2005

MODIS

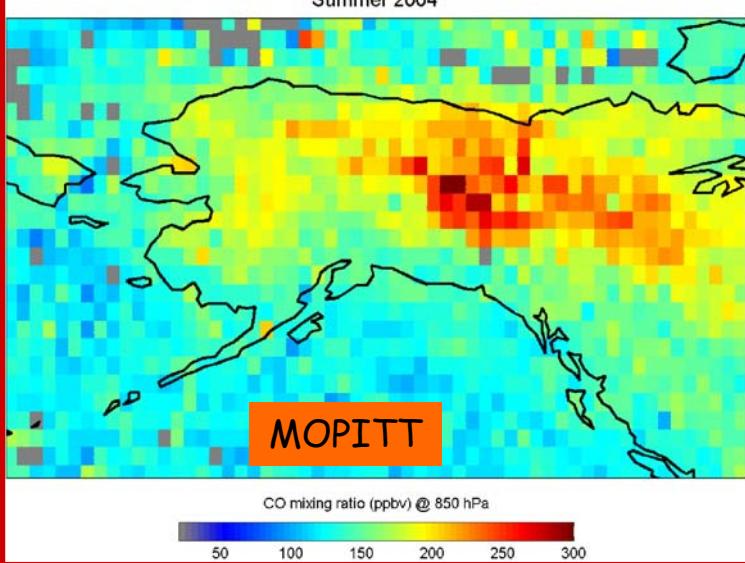


Wild fires in Alaska 2004

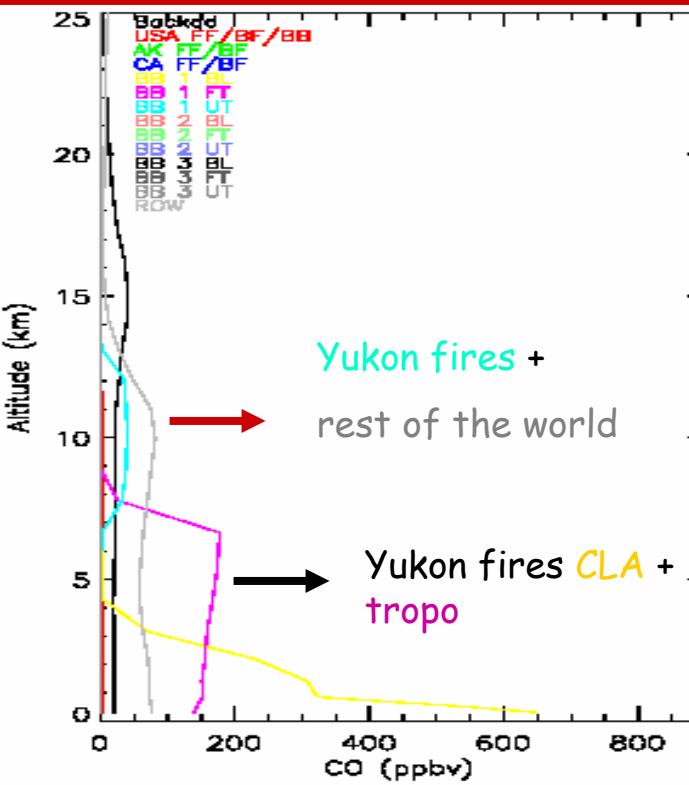
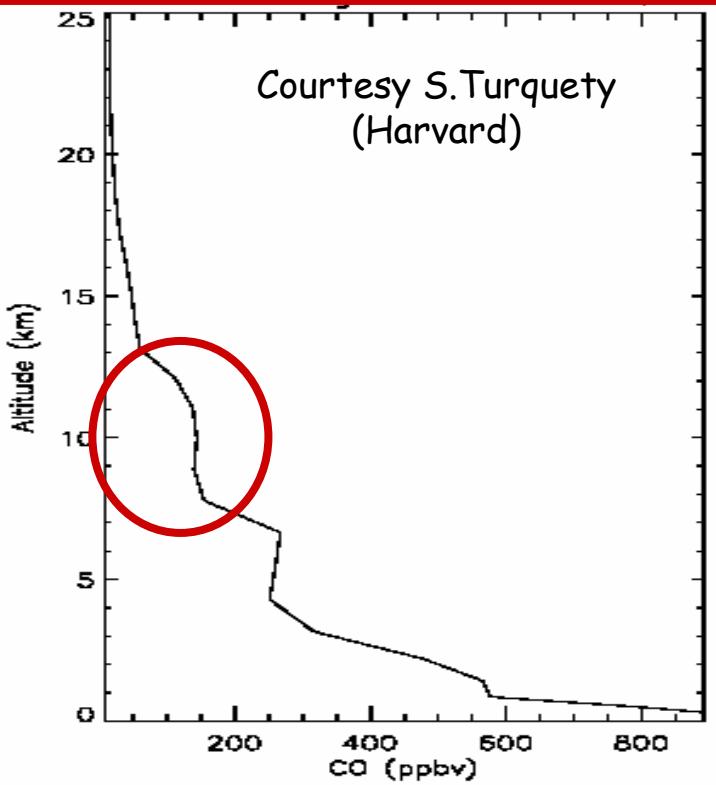
*Profil N° 3 (ACE ver. 2.0):*



Summer 2004

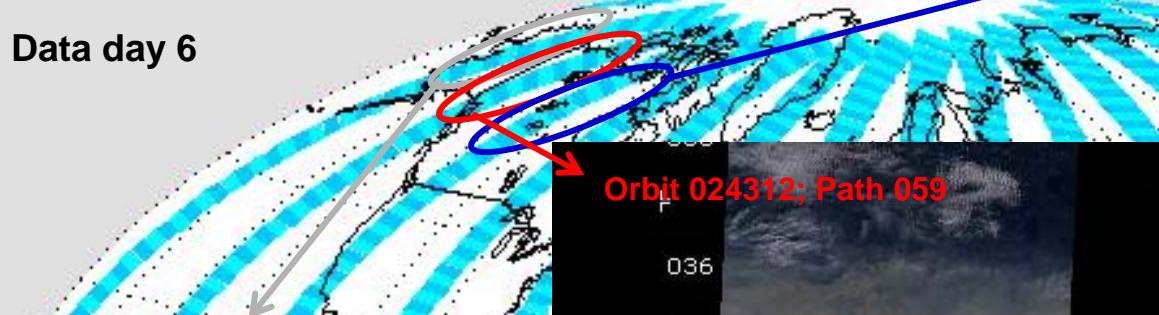


Courtesy S.Turquety  
(Harvard)



MISR 13/07/2004

Data day 6



Orbit 024311; Path 043

038

039

040

041

042

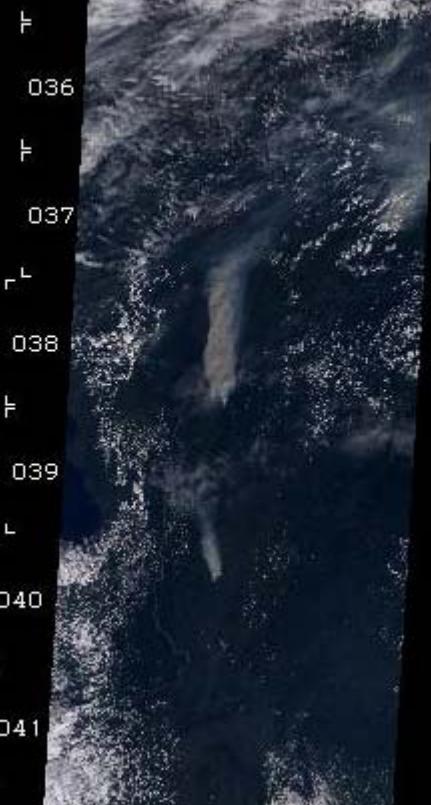
043

044

75



Orbit 024313; Path 055



Orbit 024312; Path 059

036

037

038

039

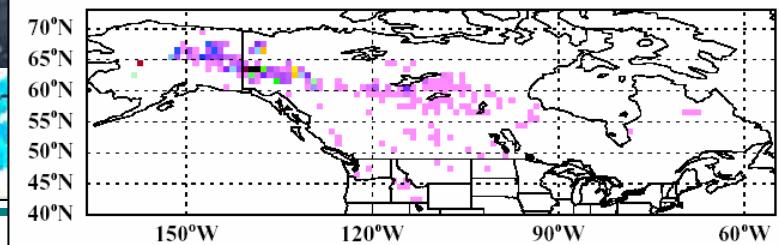
040

041

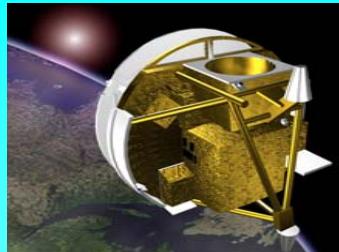
042

043

Cathy Clerbaux - November 2005 - AURA



< 1.00e-06 2.39e-02 4.77e-02 7.16e-02 9.54e-02 (Tg CO<sub>2</sub>)



## Conclusions

- ACE-FTS instrument able to measure CO profiles, from the mid-troposphere to the thermosphere with a good accuracy
- In the troposphere, the expected North-South hemispheric gradient has been identified and the effects of vertical transport due to convection in the tropical tropopause has been observed. In the strato-mesosphere, observation of CO as a tracer of the polar vortex dynamics
- Joint analysis of Mopitt CO and ACE CO to follow large emission plumes

Validation activities: ODIN, MLS, MIPAS, TES...

## Special Section:

**Bernath, P. F.**, et al. (2005), Atmospheric Chemistry Experiment (ACE): Mission overview, *Geophys. Res. Lett.*, 32, L15S01, doi:10.1029/2005GL022386.

**Clerbaux, C.** et al. (2005), Carbon monoxide distribution from the ACE-FTS solar occultation measurements, *Geophys. Res. Lett.*, 32, L16S01, doi:10.1029/2005GL022394.

**Jin, J. J.**, et al. (2005), Co-located ACE-FTS and Odin/SMR stratospheric-mesospheric CO 2004 measurements and comparison with a GCM, *Geophys. Res. Lett.*, 32, L15S03, doi:10.1029/2005GL022433.

And 12 other papers

**Rinsland C.** et al. (2005), Atmospheric Chemistry Experiment (ACE) measurements of elevated Southern Hemisphere upper tropospheric CO, C<sub>2</sub>H<sub>6</sub>, HCN, and C<sub>2</sub>H<sub>2</sub> mixing ratios from biomass burning emissions and long-range transport, *Geophys. Res. Lett.*, 32, L20S03, doi:10.1029/2005GL024214.